

The Turning Point for Einstein's Annus Mirabilis

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Abstract

The year 1905 has been called Einstein's annus mirabilis in virtue of three ground-breaking works completed over the span of a few months --- the light quantum paper (Einstein, 1905a), the Brownian motion paper (Einstein, 1905c), and the paper on the electrodynamics of moving bodies introducing the special theory of relativity (Einstein, 1905d). There are prima facie reasons for thinking that the origins of these papers cannot be understood in isolation from one another.

Due to space limitations, we concentrate primarily on the light quantum paper, since, in key respects, it marks the turning point for the annus mirabilis. The task is to probe, not just how the idea of the light quantum might have occurred to Einstein, but, more importantly, what convinced him that the idea was not just a quixotic hypothesis, but an unavoidable and demonstrable feature of radiation. The crucial development, we suggest, arose from comparing the energy fluctuations that following rigorously from the Stefan-Boltzmann law, as well as from Wien's distribution formula for blackbody radiation, with what it is reasonable to expect from Maxwell's electromagnetic theory of light. A special case of this is addressed in (Einstein, 1904). The outcome for the general case leads naturally to the central theoretical argument of the light quantum paper, the expectation of Brownian-like motion, and several of the key results for the electrodynamics of moving bodies.

Keywords: Einstein; Light quantum; Blackbody radiation; Energy fluctuations; Brownian motion; Radiation pressure

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